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Improving Students' Creativity In The Proving The Validity Of Arguments Through Learning Strategy "What's Another Way"

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Abstract

The purpose of this study was to describe the enhancing creativity of students in proving the validity of arguments through learning strategy "what's another way". This research was an action research with qualitative descriptive approach. The subjects were students of mathematics education UNIROW Tuban. The study was conducted in three cycles, Cycle I: Proof of Validity Arguments Directly, Cycle II: Proof of Validity Arguments Indirectly, and Cycle III: Validity Evidence Arguments Containing Kuantor. This research results in the following: In general, the learning strategy "what's another way" to improve the creativity of students in proving the validity of the argument. The main difficulty in proving the validity of the argument is as follows: a) the use of evidentiary rules of argument, and b) the idea of proof plan.
Key Words: creativity, proving, argument, validity, and "what's another way"

I. INTRODUCTION

Building a nation's character lately become an interesting topic for discussion. Every scientific activity is always a theme related to character education. In every subject at every learning process of habituation should cultivate a good character for students. According Udin Saripudin Winataputra (2010: 5) interpreted the character as a good personal qualities, in the sense to know the good, want to do good, and the real well-behaved, which coherently radiate as a result of intellectual development, spiritual and emotional development, physical and kinestetic development, and affective and creativity development. This study evaluated the creativity of students in proving the validity of the argument. Creativity is an aspect of affective and creativity development. Proving the validity of the argument is an aspect of intellectual development. So assessing the creativity of students in proving the validity of the argument is one of the configuration of the character education developed by the Ministry of National Education.

Polya (1973: 154) distinguishes the problem into two, namely the "problem to find" and "problem to prove". The aim of a "problem to find" is to find a certain object, the unknown of the problem. The unknown is also called "quaesitum" or the thing sought, or the thing required. "Problem to find" may be theoretical or practical, abstract

or concrete, serious problems or mere puzzles. We may seek all sorts of unknowns; we may try to find, to obtain, to acquire, to produce, or to construct all imaginable kinds of objects. The aim of a "problem to prove" is to show conclusively that a certain clearly stated assertion is true, or else to show that it is false. We have to answer the question: Is this assertion true or false? And we have to answer conclusively, either by proving the assertion true, or by proving it false.

For creativity "problem to find" have been investigated, namely profile of junior high school students' creativity with reflective and impulsive cognitive styles in solving geometric problems (Warli, 2010: 297-300). This research results in the following: 1) The creativity profile of students with reflective cognitive style in solving geometric problems tends to be high. In the phase of planning, the creativity of reflective students in planning the problem solving tends to be low. There are few of them indicating that creativity of reflective students in planning the problem solving is high. In executing phase, the creativity of reflective students in carrying out the problem solving tends to be high. 2) The creativity profile of impulsive students in solving geometric problems tends to be very low. In the phase of planning, the creativity of impulsive students in planning the problem solving tends to be very low. In executing phase, the creativity of impulsive students in carrying out the problem solving tends to be low.

The next problem is how the creativity of students in a matter of proof? The problem proved to have higher levels of thinking than the "problem of find". To prove that the problem is rarely given to high school students, but more given to students in college. In proving a problem, students must understand the role of reasoning in the proof of mathematical problems. According Gila Hanna et al. (2009: 1-xix) mathematics educators face a significant task in getting students to understand the roles of reasoning and proving in mathematics. This challenge has now gained even greater importance as proof has been assigned a more prominent place in the mathematics curriculum at all levels. The same is expressed by Todd CadwalladerOlsker (2011: 34) proof is fundamental to mathematics.

This study examines the validity of the argument proving the issue of creativity. The validity of the argument has an important role in training students to think logically. Logical thinking is fundamental in proving mathematical problems. Aiso Heinze (2004:

41) explains that reasoning, proof and argumentation in the mathematics classroom is an important issue in mathematics education research. According Gila Hanna et al. (2009: 1-xix) proof has played a major role in the development of mathematics, from the Euclidean geometry of the Greeks, through various forms of proofs in different cultures, to twentieth-century formal mathematics based on set-theory and logical deduction. To specify clearly the assumptions made and to provide an appropriate argument supported by valid reasoning so as to draw necessary conclusions. The results Martin & Harel (1989) for each statement, more than half the students accepted an inductive argument as a valid mathematical proof. More than 60% accepted a correct deductive argument as a valid mathematical proof; 38% and 52% accepted an incorrect deductive argument as being mathematically correct for the familiar and unfamiliar statements, respectively. Over a third of the students simultaneously accepted an inductive and a correct deductive argument as being mathematically valid. Todd CadwalladerOlsker (2011: 49) a structural proof includes, along with its "formal" argument, informal practices such as the inclusion of a short overview of the proof, and frequent explanatory passages in the proof itself. Referring to some opinions it can be said that the validity of the argument has an important role, because it is fundamental in proving mathematical problems.

The learning of proof and proving in school mathematics should be developmental and should start in the early grades. The success of this process would clearly depend on teachers' views about the essence and forms of proofs, on what teachers do with their students in classrooms, on how teachers interpret and implement curricular tasks that have the potential to offer students opportunities to engage in proving, and on how they diagnose students' difficulties in proving and design instructional interventions to help overcome these difficulties. Aiso Heinze (2004: 41) said that mathematical proof is one of the most difficult topics for students to learn. According Aiso Heinze (2004: 42) for the teaching and learning of proof it is not sufficient to show only the product. It is more important to stress the proof process. However Todd CadwalladerOlsker (2011: 46) explains that when discussing the pedagogy of teaching the ideas and techniques of mathematical proof. One goal of our teaching could be to help our students, at least at the undergraduate level, to begin to think like mathematicians.

In addition to knowing the students' difficulties in proving, understand the

relationship between the validity of arguments with mathematical proof can also be used as a basis for designing learning. Gila Hanna et al. (2009: 1-xxii) explains:

> ”Understanding the relationship between argumentation (a reasoned discourse that is not necessarily deductive but uses arguments of plausibility) and mathematical proof (a chain of well-organised deductive inferences that uses arguments of necessity) may be essential for designing learning tasks and curricula that aim at teaching proof and proving. Some researchers see mathematical proof as distinct from argumentation, whereas others see argumentation and proof as parts of a continuum rather than as a dichotomy. Their different viewpoints have important didactical implications.”

What is the role of creativity in the mathematical proof? In the "problem to find" creativity has a very large role in planning and working on problem resolution. Gila Hanna et al. (2009: 1-xxviii) at the tertiary level, proofs involve considerable creativity and insight as well as both understanding and using formal definitions and previously established theorems. Orton (1992: 95) also said that the stages are very difficult and complicated is the stage 2 and 3, particularly phase two in which creativity, creative ability and insight is needed. Based on these opinions can be said creativity is needed to explore new ideas in developing and working on problem solving, problem-solving resulting in an fluency and flexible. Creativity proving the validity of arguments are important, because the potential to develop the creative thinking of students, as an evidentiary basis in the problem of mathematics.

The next problem is how the learning strategies that can enhance creativity in proving mathematical problems? The teachers task is to help students so that can construct knowledge in accordance with the concrete situation, then the strategy should also be tailored to the needs and situations of students. Therefore, there is no one teaching strategy that can be used anywhere and in any situation. The strategy drawn up only to offer and suggestion, not a ready-made menu. Teaching is an art that requires not only mastery of technique, but also intuition. Principles of teaching according to the

NCTM (Van de Walle, 2006: 3) is that effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

In this study researchers tried to use learning strategies "What's Another Way" presented by Stephen Krulik & Jesse A. Rudnick. Learning strategies "What's Another Way" is a learning strategy that provides a challenge to the student after answering a problem. The challenge is to make students think back to look for alternative answers other than the answers they have made. According Krulik & Rudnick (1999: 140) the students are forced to think of other ways to approach the problem. This activity is an excellent way to practice creative thinking. Although contrived, the following problem elicits solutions that provide insight into students' reasoning.

This research question is how to increase the creativity of students in proving the validity of arguments through learning strategies "what's another way"? Based on these questions, the purpose of this study is to describe in detail the improving creativity of students in proving the validity of arguments through learning strategies "what's another way".

II. RESEARCH METHOD

This study intends to reveal improvement in student creativity to prove the validity of arguments through learning strategies "what's another way". To obtain a picture, conducted classroom action research with a descriptive qualitative approach with primary data in the form of writings and words based on the interview task.

Research subjects were students of Mathematics Education UNIROW Tuban majors Introduction to Basic Mathematics. Subjects who used only one class, numbering 38 students. The process of data collection followed the design of classroom action research. The study was conducted in three cycles, each cycle is given test (20 minutes) to test the creativity of students in the proof of the validity of the argument. The process of learning to use the strategy of "what's another way" Cycle I, the topic is given: Proving validity of arguments Directly, Cycle II, the topic is given: Proving

validity of arguments in the Indirect, and Cycle III, the topic is given: Proving validity of arguments that contain Quantor.

To analyze the validity of the argument proving creativity, from the completion of scoring students performed twice, namely achievement scores, and weighted scores. Achievement scores are the scores achieved by students in solving the task of solving the problem of proof. Weighted score is the score obtained from the multiplication achievement scores by weighting each indicator of creativity. Scoring indicators of creativity or attention to a variety of different ideas problem solving.

Based on the notion of creativity indicators, namely fluency, flexibility, and novelty can be sorted stages of creativity indicators. Novelty is the highest stage, because of the different ways to solve the problem with the previous is the main characteristic in assessing a creative product. Further flexibility, as it demonstrates the ability to generate ideas to solve the problem. Then the bottom phase of eloquence, because kafasihan fluency in generating ideas is a manifold. Referring to this, the novelty given weight 3, the flexibility given weight 2, and fluency is weighted 1.

III. RESULT AND DISCUSSION

Cycle I

The learning process in the cycle I, Proving the validity of argument directly. After the withdrawal of some rules and some of the conclusions of the argument that an equivalent statement is given, then students are given examples of how to use the equivalent statement in the rules and prove the validity of the argument. By learning strategies "What's another way" Once the sample is answered, students were asked to answer a different way. This learning strategy performed well in exercises. For example the following is the test I,

Note the argument in symbolic form below.

1. $G \vee (L \wedge T)$ Pr
2. $G \rightarrow \neg T$ Pr
3. T Pr / $\therefore L$

a. Prove directly the validity of the argument above!

b. Prove it by other means (which is different from (a)), do as much as you can.

In cycle I, students are still many difficulties. Some of the information obtained through direct interviews, among other things: 1) Students do not memorize some rules in a conclusion withdrawal, 2) individual student confused the initial steps that must be done in proving the validity of the argument (the idea of settlement planning is still lacking), and 3) Students are still confused use of an equivalent statement. The difficulty is seen in one of the answers to students (see Figure 1)

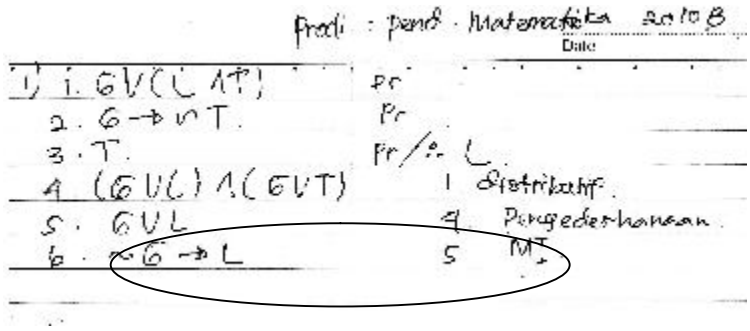

Figure 1. Examples of Student Answer is Not Creative

Based on Figure 1. Students seen already attempted to try to use the rules and statements are equivalent. But the results have not been successful (still difficult), because do not know (no idea / not creative) what next steps to reach the conclusion. Analytical results of tests on the cycle I, a student who could not answer correctly occupy the greatest proportion. Being very creative students who do not exist. The first cycle, showed that students who are not creative as much as 42.1%, less creative students as much as 31.6%, a fairly creative students as much as 13.2%, and students who are creative as much as 13.2%.

Cycle II

In cycle II, provided the material Validity of Evidence in the Indirect Argument. Like the cycle of learning strategy I used was "What's another way". On this matter there is no additional withdrawal rule conclusion. Some of the rules used in proving the validity of the argument can directly be used in the proof of the validity of the argument indirectly. Rules for indirect evidence only the beginning of the conclusion made in step

negation. In cycle II was also given a test for the problem of proving the validity indirectly. The results of the analysis to the second test showed a good increase in creativity. In cycle I is not creative reached 42.1%, and cycle II decreased to 28.9%. Likewise, in cycle I highly creative nothing, being in cycle II highly creative reached 2.6%, as shown in Figure 2. Difficulties are still encountered in the student, generally still like the previous cycle, but the proportion is declining. Difficulties that are still prominent in the second cycle, is a confused individual student to do the first step in proving the validity of the argument (the idea of the settlement plan is still difficult). Here are examples of highly creative student answers.

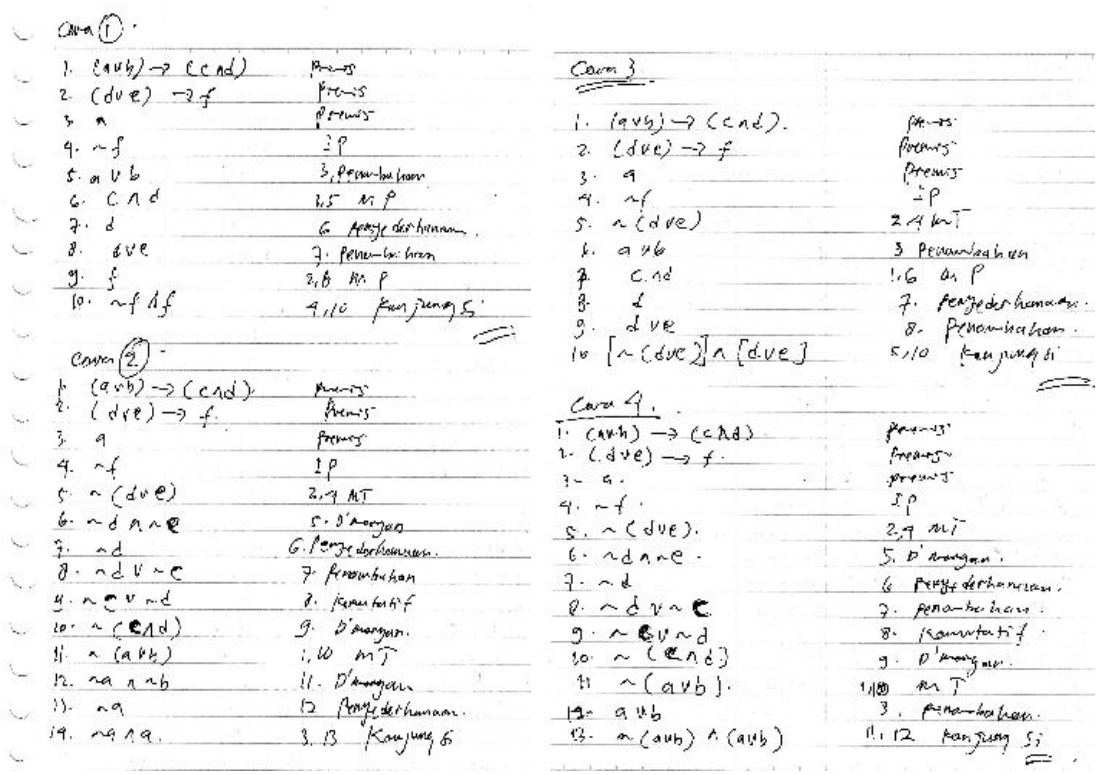

Figure 2. Examples of Student Answer is Very Creative

The second cycle, showed that students who are not creative as much as 28.9%, less creative students as much as 21.05%, a fairly creative students as much as 28.9%, students who are creative as much as 18.4%, and students are very creative as much as

2.6%.

Cycle III

In cycle III, the material provided Proving Validity Arguments Containing Quantor. On this matter there are additional rules, namely: a) Universal instantiation, b) Universal generalization, c) Existential generalization, and d) Existential instantiation. The addition of these rules, the difficulty of students come back as it did in cycle I, the student difficulties in using the new rules (additional rules). This resulted in increased creativity is not as good as when the cycle II. The analysis showed that students who are not creative still remain, namely 28.9%. Likewise, students who are very creative, which is 2.6%.

The third cycle, indicating that students who are not creative as much as 28.9%, less creative students as much as 13.2%, a fairly creative students as much as 34.2%, students who are creative as much as 21.05, and students are very creative as much as 2.6%. Overall results of the analysis of student creativity in proving the validity of the argument can be illustrated in Figure 3 below (in per cent).

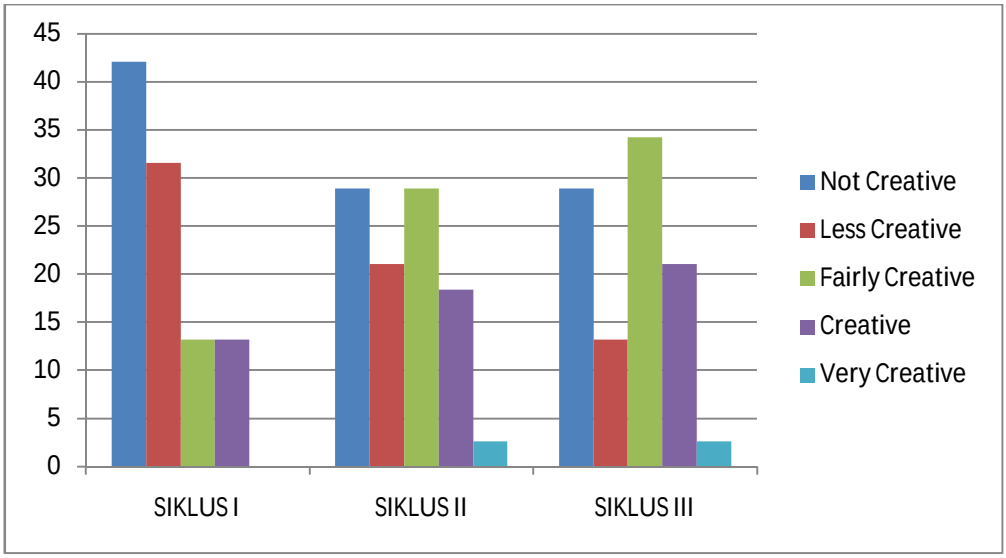

Figure 3. Profile Student Creativity

Based on Figure 3. above, it can be seen that the percentage of students who are not creative and less creative than the cycle I, II, and III decreased. Being the percentage of students who are creative enough and creative of the cycle I, II, and III increased. It

can be said that in general the use of learning strategies "what's another way" to improve the creativity of students in proving the validity of the argument.

Some student difficulties in proving the validity of the argument in outline, among others: a) use the rules to prove the validity of the argument: this is shown in cycles I and strengthened when there are additional rules on the third cycle of increased creativity of students is less good, than on the addition of second cycle the rules just a bit, and b) the idea of proving the validity of the argument plans; this is indicated by several answers that did not / less directional, because the idea of proof has not been an accurate plan, in order to obtain a wrong answer or a "dead end" (not obtained the correct answer).

IV. CONCLUSION AND SUGGESTION

Learning strategy "what's another way" is an offer that can be used to enhance the creativity of proving the validity of the argument. The research was conducted in three cycles. Based on the results of the analysis obtained the following conclusions.

The first cycle, showed that students who are not creative as much as 42.1%, less creative students as much as 31.6%, a fairly creative students as much as 13.2%, and students who are creative as much as 13.2%. The second cycle, showed that students who are not creative as much as 28.9%, less creative students as much as 21.05%, a fairly creative students as much as 28.9%, students who are creative as much as 18.4%, and students are very creative as much as 2.6%. The third cycle, indicating that students who are not creative as much as 28.9%, less creative students as much as 13.2%, a fairly creative students as much as 34.2%, students who are creative as much as 21.05, and students are very creative as much as 2.6%. In general, the learning strategy "what's another way" to improve the creativity of students in proving the validity of the argument. The main difficulty in proving the validity of the argument is as follows: a) the use of evidentiary rules of argument, and b) the idea of proof plan.

Development of creativity is one means of building character of the nation. Based

on the results of this study suggested that in order to develop the creativity of students in proving the validity of arguments can be used as an alternative learning strategy of "what's another way". Suggestions for further research is to try out this strategy in other materials or different levels of education. Thanks hopefully be useful.

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